- 1 -

ROLE MANAGED COLLABORATIVE LEARNING SUPPORT

SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

The present invention relates to a
collaborative learning support system in which a
plurality of learners learn through collaborative works
5 such as discussions via a network.

As such a collaborative learning support
system, a system called "Belvedere" is known which has
been developed by Pittsburgh University and is
described in "Groupware for developing critical
10 discussion skills" by D. Suthers, et al. (CSCL95
Computer Supported Collaborative Learning, Lawrence
Erlbaum Associates, Inc., ISBN 0-8058-2243-7).

In the Belvedere system, a server manages
structured discussion data which can be visually edited
15 by a plurality of learners via a network. The
structure data is data having a logical relation such
as "Fact X supports hypothesis A", "Fact A offers
evidence against hypothesis B" and "C and D are
required to be verified, in order to verify A".

20 Learners connected to the server via the network
constitute a virtual group, and sequentially write
discussions in discussion data shared on the server
side. With this system, learners can debate in this
manner on the network so that they can acquire

scientific reasoning abilities, communication skills or the like.

SUMMARY OF THE INVENTION

Conventional collaborative learning support
5 systems such as Belvedere are, however, associated with following insufficient considerations:

(1) Access privilege management by role should be done flexibly.

Access privilege to shared data on a server
10 is required to be managed for collaborative works. Although Belvedere performs exclusive control, it does not perform access privilege management by roles of learners. Even in a system which performs management by role, the relation between role and access privilege
15 is fixed and flexible access privilege management for each theme cannot be made.

(2) Learning progress status cannot be monitored.

There is no means for expressing the
20 intention of a teacher who designed collaborative learning processes. Therefore, the computer system cannot judge whether activities of a learning group progress in the way the teacher intended. The teacher is therefore required to carefully observe the history
25 of data exchange between learners.

(3) In the Belvedere system, learners can only perform group works of editing a set of figures

coupled by links managed by the server. The figures represent only discussions so that it is difficult to utilize these figures for collaborative learning of another theme which requires group works of another

5 kind.

It is an object of the present invention to provide a collaborative learning support system capable of solving the above-described problems.

According to one aspect of the present

10 invention, there is provided a role managed collaborative learning support system for collaborative learning between a learning management server and a plurality of clients via a network, wherein: the client comprises resource operation transmission means and

15 resource display means, the resource transmission means transmitting a request for a resource operation together with a learner ID for identifying a learner using the client, to the learning management server; the learning management server comprises resource

20 operation means for operating resources of the learning management sever in accordance with the request by the client, resource reference means for notifying the client of the contents of the resources, and operation interpretation means for interpreting the meaning of

25 the resource operation request sent to the resource operation means; the learning management server further comprises activity model data representative of a set of role names and a set of links indicating behaviors

between the role names, a role table storing a
correspondence of each learner ID and resource relative
to each role name, and an operation interpretation
table to be used for interpreting the request sent from
5   the resource operation transmission means of the client
to the resource operation means as behaviors between
the resources; the resource operation means of the
learning management server converts the request sent
from the resource operation transmission means of the
10 client into behavior descriptive data representative of
behaviors between resources and learner ID's by using
the operation interpretation table, and inquires the
operation interpretation means whether an operation
corresponding to the behavior descriptive data is
15 permitted; the operation interpretation means refers to
the role table to check whether there is a role name
assigned to the learner ID and resource and being
coincident with the contents of the activity model data
to thereby judge whether the request is permitted, and
20 returns judgement results to the resource operation
meas; and if the judgement results indicate a
permission, the resource operation means operates the
resource, and the resource display means of the client
receives resource operation results from the resource
25 operation means and displays the resource operation
results.

          According to the invention, by setting the
activity model data, role table and operation

interpretation table, an access privilege to resources can be set in accordance with the activity model data.

Other objects, features and advantages of the present invention will become apparent from the description of the embodiments of the invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the structure of a role managed collaborative learning support system according to an embodiment of the invention.

Fig. 2 is a conceptual diagram of activity model data.

Fig. 3 shows the data structure of a role table.

Fig. 4 shows the data structure of an operation interpretation table.

Fig. 5 shows the data structure of activity model data.

Fig. 6 is a block diagram showing the structure of a collaborative learning support system with a learning progress monitoring function according to another embodiment of the invention.

Fig. 7 shows the data structure of an activity log.

Fig. 8 shows a learning progress monitoring window used mainly for operations.

Fig. 9 shows a learning progress monitoring window used mainly for roles.

Fig. 10 shows the data structure of monitoring condition data.

Fig. 11 is a block diagram showing the structure of a collaborative learning support system with a resource operation plug-in function according to another embodiment of the invention.

Fig. 12 shows the data structure of resource management procedure data.

Fig. 13 is a structured chart illustrating an operation of a resource operation unit.

Fig. 14 is a structured chart illustrating an operation of an operation interpretation unit.

Fig. 15 is a structured chart illustrating an operation of an operation transmission unit.

Fig. 16 is a structured chart illustrating an operation of a learning progress monitoring unit.

Fig. 17 is a structured chart illustrating an operation of a resource operation unit of a plug-in type.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The invention will be described in detail in connection with embodiments. Fig. 1 shows the structure of a system according to an embodiment of the invention. A learning management server 1001 includes a resource operation unit 1003, a resource reference

unit 1004 and an operation interpretation unit 1002.
In order to control the operation of the server 1001,
the server 1001 has activity model data 1005, a role
table 1006 and an operation interpretation table 1007
5 which will be detailed later.

The learning management server 1001 has also
various resources 1008 which are operated by clients
1009. The resources include a bulletin board on which
messages of learners are written, a TV conference
10 system for conversation by learners, and the like. A
learner accesses the resource operation unit 1003 of
the learning management server 1001 from the client
1009 via a network. Collaborative works by a learner
group are performed by operating the resources 1008.

15 The client 1009 has a resource operation
transmission unit 1010 and a resource display unit
1011. Each learner is assigned a learner ID which is
used for identifying the learner.

First, a learner issues a request for
20 operating the resource 1008 of the learning management
server 1001 from the resource operation transmission
unit 1010 of the client 1009. This request includes
the learner ID as a subject and writeTo (bulletin
board, title, contents) as the request contents.

25 In response to the request, the resource
operation unit 1003 operates the resource 1008 managed
by the learning management server 1001, and this
operation of the resource operation unit 1003 is

notified to the requested resource operation
transmission unit 1010. The resource operation
transmission unit 1010 requests the resource display
unit 1011 to display the request result. The resource
5   display unit 1011 requests the resource reference unit
1004 of the learning management server 1001 to acquire
the contents of the resource which are then displayed
on the client 1009 side. In this manner, a plurality
of clients can access the resource 1008 of the learning
10   management server 1001 to perform collaborative
activities between the learners.

Next, an operation of managing access
privilege to the resource 1008 will be described which
is performed by the operation interpretation unit 1002
15   in accordance with the role of each learner. First,
the data to be used for controlling the system will be
described. The activity control data 1005 is data
representative of a relation between participants such
as a teacher and learners and a relation between
20   resources. The learner ID is also called a resource
hereinunder.

Fig. 2 shows the contents described by the
activity model data 1005. The activity model data
includes a plurality of named nodes called roles and a
25   plurality of named links interconnecting the nodes. In
the example shown in Fig. 2, a link named "access" is
extended from a node named "teacher" to a node named
"teaching material". This means that the role named

"teacher" can perform an activity named "access" relative to the resource having the role named "teaching material". Other links are also interpreted in similar manners.

5   Fig. 5 shows the data structure of the activity model data 1005. This data structure is a table having a "behavior name" field, a "subject" field and an "object list" field. Although each record of the "object list" has a single element in many cases,

10 it may have no element or a plurality of elements. In the last record of the object list shown in Fig. 5, two elements are described. This record "Subject: leader, Behavior name: role allocation, Object list: learner, task data" with two roles in the object list indicates

15 that the "leader" can perform a "role allocation" relative to the "learner" and can write the result as the "task data".

    Fig. 3 shows the data structure of the role table 1006. In this table, a "role" can be written in

20 each of a plurality of models for each "resource ID". A learner ID or a resource name is written as the "resource ID". A set of roles assignable to the "resource ID's" of each model is written in the "role" field. This table is used for assigning roles to the

25 learners ID's and resources in the "resource ID" field. The first record of the table shown in Fig. 3 is "Resource ID: user A, roles of the first model: leader, learner" which indicates that the "leader" or "learner"

is assigned as the role of the learner ID "user A".

Fig. 4 shows the data structure of the operation interpretation table 1007. This table has three fields including an "operation pattern" field, a

5 "behavior" field and an "object list" field. This table indicates that if the operation request sent from the resource operation unit 1003 matches an operation pattern, the operation described in the "behavior" field is performed with respect to the object written

10 in the "object list" field.

With reference to the above-described data, the operation of the resource operation unit 1003 will be described in detail with reference to the above-described data structures and Fig. 13. At Step 13001,

15 each time when a request for a resource operation is input from a client, the resource operation unit 1003 executes a series of Steps starting from Step 13002.

First, at Step 13002 a "REQUEST" is received. At Step 13003 the learner ID of REQUEST is stored in

20 the "subject" and the request contents are set as F(A0, A1, ..., An). At Step 13004 by referring to the operation interpretation table 1007, the "object list" and "behavior" are derived from F(A0, A1, ..., An).

Next at Step 13005 the "subject", "object

25 list" and "behavior" are sent to the operation interpretation unit 1002 to inquire whether the operation can be permitted. At a condition judgement Step 13006 it is judged whether the results indicate

that the operation can be permitted (refer to Fig. 14).
If this judgement is asserted, it means that it is
judged that the operation interpretation unit 1002 can
perform the operation and that the resource 1008 is
5   actually operated in a series of processes at Step
13007 and following Steps. At Step S13008 the resource
operation transmission unit 1010 on the "subject" side
is notified of the completion of the resource
operation. If it is judged at the judgement Step 13006
10 that the judgement is negated, then at Step 13009 it is
notified via the resource operation unit 1003 that the
REQUEST" of the client 1009 of the "subject" cannot be
performed.

        Next, with reference to Fig. 14, the
15 operation of the operation interpretation unit 1002
will be detailed. At Step 14001, each time when an
inquiry is sent from the resource operation unit 1003,
the operation interpretation unit 1002 executes a
series of Steps starting from Step 14002 to respond the
20 inquiry.

        First, at Step 14002 the inquiry is
decomposed into the "subject", "object list" and
"behavior". At Step 14003 the role table 1066 is
checked to judge whether there are any assigned role
25 elements of the subject and object list which satisfy
the activity model data 1005. Satisfying the activity
model data 1005 means that a link from the "subject"
node named "behavior" to the element "object list"

exists in the activity model data 1005.

If it is judged at a condition judgement Step
14004 that the link exists, it means that the operation
can be permitted so that at Step 14005 the resource
5   operation unit 1003 is notified of a permission of the
operation. If the judgement Step 14004 is negated,
then at Step 14006 the resource operation unit 1003 is
notified of an inhibition of the operation.

Next, with reference to Fig.15, the operation
10 of the operation transmission unit 1010 on the client
1009 side will be detailed. First, at Step 15001 the
client ID is acquired. The client ID may be assigned
beforehand or it may be assigned by the server when the
client logs in by using a user name. In either case,
15 it is assumed that the learner ID is assigned to each
learner.

At Step 15002 each time a user enters
REQUEST, a series of processes starting from Step 15003
is performed. First, at Step 15003 REQUEST is
20 received.

Next, at Step 15004 REQUEST and ID are sent
to the resource operation unit 1003. It is checked
whether a condition judgement Step 15005 asserts. If
the judgement Step asserts, then at Step 15006 the
25 resource display unit 1011 is requested to display the
operation results. If the judgment Step 15005 negates,
then at Step 15007 a message that there is no privilege
for operating the resource is displayed.

With the above processes, it is possible to provide a collaborative learning support system capable of freely setting role and privilege in accordance with the settings of the activity model data 1003.

5   Next, with reference to Fig. 6, a collaborative learning support system having a function of monitoring the operation status of a learner will be described. In the system shown in Fig. 6, in addition to the constituent elements shown in Fig. 1, the learning management server 1001 is provided with a learning status monitoring unit 6003, an activity log 6001 and monitoring condition data 6002. These unit, log and data are added in order for a monitoring status display unit 6004 to receive a display request from the learning status monitoring unit 6003 via the network.

     Fig. 7 shows the data structure of the activity log 6001. This data structure has fields "behavior name", "subject", "object list", "count" and "history". The data structure of the "behavior name", "subject" and "object list" fields is the same as the data structure 5001 of the activity model data 1005. The "count" field is used for storing the number of behaviors performed by the client. The "history" field is used for sequentially storing behaviors performed by the client 1009.

     Fig. 8 shows how the number of behaviors stored in the activity log 6001 is displayed by the monitoring status display unit 6004. In this example,

the link "teach" from the "teacher" to "learner" is
displayed bold. This means that the behavior "teach"
was performed a number of times between these roles.
The link "access" from the "teacher" to "learning
5 material" is displayed as a broken line. This means
that the behavior "access" was scarcely performed. The
thickness of a link to be displayed can be determined
from the number of counts in the "count" field of the
activity log 6001 sent from the learning status
10 monitoring unit 6003 to the monitoring status display
unit 6004.

Fig. 9 shows an example of a bar graph
showing the number of executed roles at each resource
ID displayed by the monitoring status display unit
15 6004. This display can be realized by making the
learning status monitoring unit 6003 calculate the
number of roles assigned to the resource of each
"subject" by using the "history" of the activity log
6001.

20 Fig. 10 shows the data structure of the
monitoring condition data 6002. In the example shown
in Fig. 10, the restrictions of the lapse time and
activity number of each role corresponding to each
resource ID can be written by a logic formula.

25 Next, with reference to Fig. 16, how the
learning status monitoring unit 6003 utilizes the
monitoring condition data 6002 will be detailed.
First, at Step 16001 the log data written in the

activity log 6001 is decomposed into "model",
"subject", "role", "object list and role assignment"
and "behavior". Next, at Step 16002 the monitoring
condition data 6002 is checked to evaluate each
5 monitoring condition.

Lastly at a condition judgement Step 16003 it
is checked whether there is any monitoring condition
satisfied. If there is any monitoring condition
satisfied, then at Step 16004 this fact is notified to
10 the monitoring condition display unit. In this manner,
even if the teacher does not check the learning status
of each learner, a collaborative learning support
system capable of monitoring learners can be configured
only by writing the monitoring conditions.

15 Although the monitoring condition is set to
each role corresponding to the learner ID as shown in
the monitoring condition data of Fig. 10, a table
having only the "role" and "monitoring condition"
fields may be used. In this case, generally the
20 monitoring condition can be set to the role. For
example, the monitoring condition of the behavior of
the role "leader" can be set.

Next, with reference to Fig. 11, a
collaborative learning support system capable of
25 implementing various resource operations will be
described. In Fig. 11, the operation interpretation
table 1007 shown in Fig. 1 is not used but a resource
management procedure table 11001 is used. The data

structure of this table is shown in Fig. 12. The
resource management procedure table 11001 has three
fields "operation pattern", "interpretation method" and
"operation method". The "operation pattern" is a

5   pattern of a request for a resource operation sent from
the client 1009. The "interpretation method" is a
function for returning the "object list" and "behavior"
in response to the request. The "operation method"
field stores a function of operating a resource.

10   Lastly, with reference to Fig. 17, the
operation of the resource operation unit 1003 will be
detailed. At Step S17001, each time when a request for
a resource operation is input from a client, the
resource operation unit 1003 executes a series of Steps

15   starting from Step 17002. First, at Step 17002
"REQUEST" is received. At Step 17003 the learner ID of
REQUEST is stored in the "subject" and the request
contents are set as F(A0, A1, ..., An). At Step 17004
by referring to the resource management procedure table

20   11001, an item having F(A0, A1, ..., An) as the
operation pattern is searched. At a condition
judgement Step 17005 it is checked if such an item
exists. If this judgement Step is asserted, a series
of processes starting from Step 17006 is performed to

25   operate the resource.

          First, at Step 17006 an operation method
program M is derived from the searched item to call the
program M(A0, A1, ..., An) and obtain the "subject" and

"object list". At Step 17007 the "subject", "object
list" and "behavior" are sent to the operation
interpretation unit 1002 to inquire whether the
operation can be permitted. At a condition judgement
5   Step 17008 it is judged whether the results indicate
that the operation can be permitted. If this judgement
is asserted, a series of processes starting from Step
17009 is performed to operate the resource.

At Step 17009 the REQUEST is permitted and
10   the resource is operated. At Step S17010 the resource
operation transmission unit 1010 on the "subject" side
is notified of the completion of the resource
operation. If it is judged at the judgement Step 17008
that the judgement is negated, then at Step 17011 the
15   "subject" is notified that the REQUEST" of the client
1009 cannot be performed. If the judgement Step 17005
is negated, then at Step 16012 the fact that there is
no method for performing the REQUEST is returned to the
resource operation transmission unit of the "subject".
20   In this manner, the interpretation of the REQUEST" can
be performed by utilizing the resource operation
registered for the resource operation unit 1003 and the
activity model data. Different types of resource
operations can therefore be added as desired.

25   According to the present invention, an access
privilege of a learner to shared resources can be
decided by referring to the activity model data
describing the relation between roles and the learner

role assignment. Flexible access control is therefore
possible. The collaboration status of learners can be
monitored efficiently by using roles and behaviors
stored as the activity model data. Since new resource
5 operations can be added, a collaborative learning
support system capable of various collaborative works
can be provided.

It will be further understood by those
skilled in the art that the foregoing description has
10 been made on embodiments of the invention and that
various changes and modifications may be made in the
invention without departing from the spirit of the
invention and scope of the appended claims.